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## Bringing agroecology to scale: key drivers and emblematic cases

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### ABSTRACT

Agroecology as a transformative movement has gained momentum in many countries worldwide. In several cases, the implementation of agroecological practices has grown beyond isolated, local experiences to be employed by ever-greater numbers of families and communities over ever-larger territories and to engage more people in the processing, distribution, and consumption of agroecologically produced food. To understand the nonlinear, multidimensional processes that have enabled and impelled the bringing to scale of agroecology, we review and analyze emblematic cases that include the farmer-to-farmer movement in Central America; the national peasant agroecology movement in Cuba; the organic coffee boom in Chiapas, Mexico; the spread of Zero Budget Natural Farming in Karnataka, India; and the agroecological farmer–consumer marketing network “Rede Ecovida,” in Brazil. On the basis of our analysis, we identify eight key drivers of the process of taking agroecology to scale: (1) recognition of a crisis that motivates the search for alternatives, (2) social organization, (3) constructivist learning processes, (4) effective agroecological practices, (5) mobilizing discourses, (6) external allies, (7) favorable markets, and (8) favorable policies. This initial analysis shows that organization and social fabric are the growth media on which agroecology advances, with the help of the other drivers. A more detailed understanding is needed on how these multiple dimensions interact with, reinforce, and generate positive feedback with each other to make agroecology’s territorial expansion possible.

### KEYWORDS

Agri-food system transformation; farmer-to-farmer; massification of agroecology; scaling out; territorialization of agroecology

## Introduction

The science and practice of agroecology offer us the foundations for radically transformed food systems (Gliessman 2015; Wezel et al. 2009). Increasingly, agroecology is a key element of a growing, emancipatory movement to increase the power and control of farmers over their own production; to foster transformative social processes for the diffusion of agroecological

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practice; and to broaden access to food grown in healthy, environmentally friendly ways (Altieri and Toledo 2011; Martínez-Torres and Rosset 2014; Rosset and Altieri 2017; Rosset and Martínez-Torres 2012). Despite the recognition gained by agroecology in recent years (International Assessment of Agricultural Science and Technology for Development (IAASTD) 2008; IPES-Food 2016), few cases in which more than a few hundred farmers in a given region have adopted agroecological practice have been documented with depth and detail.

This paucity of documented cases is understandable in light of the massive constellation of policies, institutions, and corporations dedicated to creating and maintaining an ideal economic and policy environment for the industrial agriculture model (McMichael 2013; Van Der Ploeg 2008). However, the success of agroecology in the face of such opposition merits investigation. Industrial agriculture has contaminated soils, water, and air; eroded soils and biological diversity; caused pest outbreaks; led to the indebtedness of farmers; and contributed greatly to the abandonment of the countryside (Carroll, Vandermeer, and Rosset 1990; Lappé, Collins, and Rosset 1998). Furthermore, industrial agriculture has failed in its promise to end hunger (De Schutter 2010; Patel 2007). Under the neoliberal regime, industrial agriculture is one of the many tools for – and causes of – resource grabbing by economic elites (Borras et al. 2012). Understanding where and how agroecology has overcome these barriers is essential for further development of the movement.

Agroecological practice draws upon and emphasizes farmer and peasant knowledge and is best understood not as a set of recipes, but rather as principles applied in accordance with the unique reality of each farmer (Altieri 1995; Gliessman 2015; Rosset and Altieri 2017). A fully agroecological farm would be based on cultivated and not cultivated biodiversity, including the integration of crops, trees, and livestock, at the plot, farm, and landscape levels (Nicholls, Parrella, and Altieri 2001; Perfecto, Vandermeer, and Wright 2009; Altieri and Rogé 2009; Gliessman 2015). On the other hand, input substitution strategies (e.g. replacing chemical pesticides with microbial pesticides or commercial compost in place of synthetic fertilizers) are sometimes considered agroecological techniques. While such strategies may be more ecologically and socially acceptable than those they replace, they can also maintain the dependency of farmers upon purchased inputs and may have unintended ecological consequences (Rosset and Altieri 1997; Gliessman 2015; Vandermeer and Perfecto 2017). In the long run, agroecology aims to reduce dependence upon external inputs, thereby contributing to the autonomy of food-producing families and communities (Rosset and Martínez-Torres 2012). At its most ambitious, agroecology proposes the organization and connection of consumers, producers, and others to form fair, environmentally responsible

food systems, as well as broader movements for social, political, and economic justice (Gliessman 2011; Rosset and Martínez-Torres 2012).

Thus, bringing agroecology to scale is situated within the pressing need to transform agri-food systems (Altieri and Nicholls 2008, 2012; Parmentier 2014; Rosset and Altieri 2017). We define the “massification,” scaling, “amplification,” or “territorialization” of agroecology as a process that leads ever-greater numbers of families to practice agroecology over ever-larger territories and which engages more people in the processing, distribution, and consumption of agroecologically produced food. For agroecology to be scaled, it must expand and consolidate along several axes (International Institute of Rural Reconstruction (IIRR) 2000; Gonsalves 2001, Ranaboldo and Venegas 2007, Altieri and Nicholls 2012, Parmentier 2014, Brescia 2017). Scaling combines vertical (scaling-up) and horizontal (scaling-out) processes (International Institute of Rural Reconstruction (IIRR) 2000; Rosset and Altieri 2017). The former are mostly institutional in nature, while the latter comprise geographical and social spread to more people and communities and are often associated with grassroots movements (International Institute of Rural Reconstruction (IIRR) 2000; Rosset and Martínez-Torres 2012). Scaling means that a greater fraction of the population, both urban and rural, can produce and access healthy, nutritious, diverse food that is environmentally compatible and culturally appropriate (Rosset 2015; Rosset and Altieri 2017).

Here, we contribute to the theoretical understanding of agroecology’s scaling processes by analyzing five cases of massification around the globe and identifying key factors in each case that allowed agroecology to grow beyond isolated, local experiences. We selected the five emblematic cases based on their territorial reach, the thousands of families involved, the extent and quality of their documentation, and our direct experience with each one. Ours is not a comprehensive review of instances of agroecological scaling nor do we explore each case exhaustively. Instead, we identify necessary and contributing drivers of scaling and analyze across cases the relative significance of these. We also make an initial attempt to elucidate the complex relations among these drivers so that strategies for advancing agroecological transformations might be formulated and evaluated. Works by Gonsalves (2001) and Parmentier (2014) have already identified several key elements of scaling. The former provides guidance to NGOs and development agencies that promote agroecology, while the latter focuses upon policy prescription. We argue that although allies in NGOs, governments, and other sectors can contribute key resources and help create an environment conducive to scaling, successful scaling processes are grounded in broad-based, inclusive social movements (Khadse, Rosset, and Ferguson 2017; McCune et al. 2016, 2017; Rosset 2015; Rosset and Altieri 2017; Rosset et al. 2011).

### **Case 1: the *Campesino a Campesino* movement in Mesoamerica**

The *Campesino a Campesino* (CaC) movement was born in the early 1970s in Chimaltenango, Guatemala, as an effort of Kaqchikel Maya farmers, with some support from OXFAM and World Neighbors (Holt-Giménez 2006). The farmers drew upon traditions of labor sharing; horizontal pedagogical practices congruent with the “action-reflection-action” praxis of Paulo Freire (1970); Latin American popular education; Liberation Theology; and the indigenous culture to which they pertained (*op cit.*). Indigenous peasant farmers used cross visits, demonstration plots, and small-scale experimentation to teach each other techniques for soil and water conservation, such as green manure, living and non-living contour barriers, crop diversification, and intensive bio-horticulture. These agronomic improvements, along with the organization of the Kato-Ki cooperative, increased production and incomes. The *campesinos* began to liberate themselves from plantation labor and even to purchase and redistribute land from neighboring coffee farms. But during the brutal repression of the 1980s, *latifundistas* called in the Guatemalan military to crush Kato-Ki.

Many of CaC’s farmer-extensionists fled. With help from NGOs, they found work with grassroots projects in Mexico, Honduras, and Nicaragua, where they broadened their experience with sustainable agriculture as well as their organizational skills (Holt-Giménez 2006). Because of this diaspora, the CaC methodology spread to diverse organizations throughout the region. Among the most successful were the Mexican peasant organizations *Centro de Desarrollo Integral Campesino de la Mixteca* (CEDICAM)<sup>1</sup> in Oaxaca and the *Grupo Vicente Guerrero*,<sup>2</sup> in Tlaxcala (Boege and Carranza 2009). These groups adapted the Guatemalan methodology to their own social context and developed a broader methodological and technical repertoire. Beginning in 1986, farmers from Vicente Guerrero, again with NGO backing as well as tepid support from the Sandinista government, brought their methodology to the Nicaraguan *Union Nacional de Agricultores y Ganaderos* (UNAG). This organization was a founding member of La Via Campesina (LVC), a transnational peasant movement.<sup>3</sup> In Nicaragua, CaC grew into a broad-based movement for social change based upon sustainable peasant agriculture (agroecology), reaching 30,000 peasant families distributed across much of the country. This “resistance movement,” as it was defined by its actors, bolstered the peasantry against the threats of industrial agriculture by promoting socially, culturally, economically, and environmentally sustainable farming (Holt-Giménez 2006).

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<sup>1</sup><http://www.cedicam-ac.org/inicio>.

<sup>2</sup><http://vicenteguerrero.blogspot.org/>.

<sup>3</sup>UNAG later withdrew from LVC.

### ***Case 2: ANAP and the agroecological revolution in Cuba***

Cuba was the Latin American country that adopted the green revolution's technological package with greatest intensity (Machín Sosa et al. 2010, 2013; Rosset et al. 2011). However, agroecology was key in helping Cubans survive the crisis caused by the collapse of the socialist bloc in 1989–1990 and the subsequent tightening of the US trade embargo. Cuban peasants were boosted food production without scarce, expensive inputs by first substituting ecological inputs for imports that were no longer available and then through a transition to more diverse, agroecologically integrated farming systems. Key practices have included soil conservation, crop rotation, green manure and compost, polycultures and agroforestry, biological control of pests, integration of livestock with crops, and diversification. Cuban agriculture's necessarily rapid transition was possible not so much because appropriate alternatives became available, but because of the CaC social-process methodology that the National Association of Small Farmers (ANAP) – a member of LVC – learned from Mesoamerica, then adapted and used to build a grassroots agroecology movement.

Between introduction of the methodology in 1997 and 2010, about one-third of all peasant families in Cuba came to participate in the “Farmer to Farmer Agroecology Movement” within ANAP (Machín Sosa et al. 2010, 2013; Rosset et al. 2011; Val 2012). This movement has since grown to include some 200,000 peasant families, about one-half of the Cuban peasantry. During the same period, the Cuban peasants' contribution to national food production has increased significantly, due at least in part to this movement. This rapid spread of agroecology was attributable principally to the social-process methodology and to the social movement dynamics the movement created. Evolving agroecological practice contributed to the significant increase in the peasant sector's relative and absolute production and resulted in additional benefits, including resilience in the face of climate change (Rosset et al. 2011; Funes and Vázquez 2016).

### ***Case 3: organic coffee boom in Chiapas, Mexico***

The thousands of indigenous peasants in Chiapas, Mexico, who supply world markets with organic coffee offer another instructive case of agroecological scaling (Martínez-Torres 2006). The process has been influenced, driven, and supported by Liberation Theology and the Indigenous Theology of the Catholic Church, with their fundamental tenet of a preferential option for the poor (Hernández-Castillo 2010). The recovery of ancestral and popular knowledge associated with Maya cosmovision has been central elements of the boom (Hernández-Castillo and Nigh 1998), along with crop diversification; agroecological soil management; strengthening of indigenous identity;

organization of cooperatives; and fair trade links through *Max Havelaar* and other labels (Martínez-Torres 2006; Renard 2003). A key turning point was the 1989 closing of the Mexican Coffee Institute (IMECAFE), which had controlled coffee exports. The dismantling of IMECAFE coincided with the fall in international prices and with the loss of yields and profitability.

That combination of events constituted both a crisis for peasant coffee producers and (ultimately) an opportunity (Martínez-Torres 2006). In response to the crisis, an organized process began for the commercialization of organic coffee under organic and fair-trade schemes. That process, which ensured a better price for the producing families (Martínez-Torres 2006), was made possible by a constellation of actors. Among them were cooperatives backed by Liberation Theology; left-wing political groups present in the region since the 1970s; cooperatives that IMECAFE itself had supported for three decades; and other self-organized cooperatives (Martínez-Torres 2006; Nigh 2002). Other important factors were the physical infrastructure created during the IMECAFE period and links with the experience of Oaxaca's Union of Indigenous Communities of the Isthmus Region (UCIRI), which had already established marketing schemes for organic coffee. The coops drew from examples of successful agroecological and agroforestry practices provided by the *Finca Irlanda* operation and by Guatemalan agroecology promoters who had been displaced by that county's civil war. In addition, exchanges among the indigenous farmers themselves occurred more spontaneously (Martínez-Torres 2006). This strong movement, linked to export and mediated by organic certification labels (Martínez-Torres 2006), now includes 31,000 farm families, mostly indigenous, working in a region that covers 72,000 hectares. These organic coffee farmers obtain roughly the same yields as conventional farmers with higher profit margins (Martínez-Torres 2006).

#### **Case 4: Zero Budget Natural Farming (ZBNF) in India**

Zero Budget Natural Farming (ZBNF), a set of methods that agronomist Subhash Palekar put together based upon traditional practices and agroecology, has become the foundation for a grassroots peasant movement that has spread to various states in India (Khadse, Rosset, and Ferguson 2017). It has attained wide success, especially in the southern Indian state of Karnataka where it first evolved. The movement found fertile ground in the organizational landscape of the Karnataka State Farmers Association (KRFS), a member of LVC. Participation in Karnataka alone is estimated at roughly 100,000 farmer families; at the national level, it may run into the millions according to ZBNF leaders. This level of participation has been achieved without any formal organization, paid staff, or even a bank account. The movement benefits from a spirit of volunteerism among its peasant farmer

protagonists. Part of the appeal to farmers comes from Palekar's charisma and powerful mix of Hindu cosmology and resistance to both transnational corporations and the green revolution (Bhattacharya 2017; Khadse, Rosset, and Ferguson 2017).

At the local level, the movement is run informally, with a self-organized dynamic. Most farmers who practice ZBNF are connected to each other informally and carry out both organized and spontaneous farmer-to-farmer CaC-style exchange activities. Leaders tend to emerge naturally from the grassroots. At the state level, the main organized activities are training camps run by Palekar. The camps last up to five days, with about eight hours of classes each day. Attendance ranges from 300 to 5000 farmers. Farmer-to-farmer networks, cross visits, and farmer-mentor relationships develop from the contacts made at the camps (Khadse, Rosset, and Ferguson 2017).

Survey respondents reported that ZBNF is effective for farmers in agronomic, social, and economic terms (Khadse, Rosset, and Ferguson 2017). Most reported that sustained use of ZBNF practices – such as biofertilizers, biological pest control, contours, polycultures, and mulch – improved yields, soil conservation, seed diversity, quality of produce, household food autonomy, income, and health. Motivations commonly cited by farmers for joining the ZBNF movement include the health of their families, food self-sufficiency, and reduced production costs. Most reduced their farm expenses and thus their need for credit, one of the major problems plaguing Indian farmers.

### **Case 5: Rede Ecovida in Southern Brazil**

The *Rede Ecovida* (“EcoLife Network”) was created formally in 1998. However, it can be traced back to the 1970s and 1980s, when parallel social movements were confronting both land concentration and the environmental and socioeconomic damages occasioned by modern, agrochemical-based agriculture (Charão and Oliveira 2016). The combination of these menaces, and of organizations formed to confront them, created conditions for various alternative-agriculture initiatives, which later came to be called “agroecology.” These initiatives were linked with the *Rede Tecnologia Alternativa-Sul* (“Alternative Technology Network – South, Rede TA-Sul”), which was linked, in turn, to the national *Rede Projeto em Tecnologia Alternativa* (Rede PTA). Additional links were formed with processes promoted by the Catholic Church's *Pastoral de la Tierra* (“Land Pastoral”), which was based upon liberation theology, and with other local organizations searching for alternatives (Charão and Oliveira 2016). *Ecovida* now comprises NGOs, groups, consumer cooperatives, and cooperatives and organizations of peasant farmers who practice agroecology. *Ecovida* has a decentralized structure

in 150 municipalities in the three southern states of Brazil: Rio Grande do Sul, Santa Catarina, and Paraná. The movement has expanded to 29 farmers' organizations, 2,700 family farmers, 10 consumers' cooperative, 25 associations, and 30 agro-industries located in 18 municipalities, with more than 180 farmers' markets (Ecovida 2017).

Although *Ecovida* focuses on nested markets (Hebinck, Schneider, and Van Der Ploeg 2014), its members' activities are rooted in agroecological practices. Members follow principles of horizontality, solidarity, justice, and care for nature, all of which permeate the governing logic of their activities, and therefore go beyond marketing and profit making. *Ecovida's* participatory certification program started in the late 1990s as a response to the government's attempts to regulate organic production (Perez-Cassarino 2012). The certification program is an example of *Ecovida's* horizontal pedagogical approach, whose goal is transformative learning (Radomsky 2010). *Ecovida* members follow their systemic understanding of agroecology and promote a solidary economy between producers and consumers (Perez-Cassarino 2012). The structure of that economy allows for different configurations of markets, ranging from door-to-door peddling, to farmers' markets, to sales to community canteens, consumer groups, restaurants, and an intermarket commercialization circuit within three states (Charão and Oliveira 2016; Perez-Cassarino 2012).

### **Key drivers in the massification of agroecology**

Eight interrelated drivers emerged from our analysis of these five cases. Those drivers can act alone or together to promote and sustain territorial scaling of agroecology<sup>4</sup>: (1) crises that drive the search for alternatives; (2) social organization; (3) constructivist teaching–learning processes; (4) effective agroecological practices; (5) mobilizing discourse; (6) external allies; (7) favorable markets; and (8) political opportunities and favorable policies. At the beginning of a particular process, one or a few of these drivers may drive scaling. However, positive feedback and virtuous synergisms arise among drivers as scaling advances, thereby activating other drivers and bringing them to bear. We propose as a working hypothesis that broad, strongly articulated, resilient scaling of agroecology results from integration of several drivers. The eight drivers seem to have been key to the scaling-up of agroecology in most or all of these five cases. Other drivers undoubtedly contribute in some cases. Furthermore, access to land for farmer families is a necessary precondition for agroecology and its growth. With these caveats, we now describe how these drivers determine agroecological scaling.

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<sup>4</sup>Rosset (2015), Khadse, Rosset, and Ferguson (2017), and Rosset and Altieri (2017) offer similar lists.

### ***Driver 1: crises that encourage the search for alternatives***

To varying degrees, each of the five cases arose in the context of crises in one or more facets of the food system and, in some cases, the broader society. These crises, diverse in origins and expressions, set the stage for transformation but were never the sole drivers of massification.

When the *CaC* movement began in Nicaragua in the mid-1980s, the country was at war, economically embargoed by the United States, and suffering from degraded soils, low yields, a deep food shortage, and unprecedented hyperinflation (Vásquez and Rivas 2006). In Cuba, the agroecological movement gained prominence in the context of the fall of the Soviet bloc, the worsening of the US economic blockade, a widespread food shortage, and the exhaustion of the agro-industrial model (Machín Sosa et al. 2010, 2013; Rosset et al. 2011). In Chiapas, the coffee sector's crisis during the late 1990s was due to the confluence of high input costs, declining yields, collapse of international coffee prices, and the dismantling of IMECAFE (Hernández-Castillo and Nigh 1998; Martínez-Torres 2006). In India, the crisis was marked by overwhelming peasant indebtedness that led to an unprecedented epidemic of suicides – an average of one farmer suicide every 30 min – coupled with low incomes due to falling market prices and rising costs of green revolution inputs (Khadse, Rosset, and Ferguson 2017; Misra 2008; Mohanty 2005; Vakulabharam 2013; Vyas 2005).

These crises created political opportunities and propitious contexts for alternatives to the agro-industrial model. Within such climates, the seeds of agroecological massification could germinate and then be nurtured by the suite of interacting drivers we describe below.

### ***Driver 2: social organization and intentional social process***

Social organization is the culture medium upon which agroecology grows. Social-process methodologies accelerate this growth (Rosset 2015; Rosset and Altieri 2017). Imagine a farm family that is not part of any organizational fabric. The family may transform its farm agroecologically, but other farmers may have no obvious way to learn from or emulate the family's experience. In contrast, if that family is part of an organization that carries out farmer-to-farmer exchanges, those exchanges could easily have a multiplier effect.

The experience of rural social movements, and of farmer and peasant organizations, indicates that the degree of organization (called *organicidad* or “organicity” by social movements) is a key element in bringing agroecology to scale, as is the extent to which horizontal social methodologies based upon peasant and farmer protagonism are employed to construct social processes collectively. Increasingly, peasant organizations themselves are sponsoring farmer-to-farmer processes and agroecology schools (McCune et al. 2016, 2017; Rosset 2015; Rosset et al. 2011; Rosset and Martínez-Torres 2012).

Social organization and process played a key role in each of the five cases reviewed for this article. That role is most immediately apparent in the Nicaraguan and Cuban cases where CaC social-process methodology led to rapid scaling of agroecology (Holt-Giménez 2006; Rosset et al. 2011). We have argued elsewhere that agroecology spread much more rapidly in Cuba than in Central America because of ANAP's greater degree of organicity and the greater intentionality with which ANAP took on and promoted CaC methodology (Rosset et al. 2011).

We have also argued that ZBNF took off in Karnataka state because it took root in communities that already had a rich organizational fabric provided by the KRRS farmer organization (Khadse, Rosset, and Ferguson 2017). In Chiapas, Martínez-Torres (2006) has shown that a previous cycle of social capital formation by peasant coffee cooperatives laid the groundwork for the rapid uptake of organic farming methods and for the cooperatives' appropriation of new markets that opened up for labeled coffee. In Brazil, the *Ecovida* network is, in effect, an organizational structure based upon a social process and a methodology for linking existing farmer and consumer coops (Lamine, Darolt, and Brandenburg 2012). In all cases, social organization and process was the driver that made scaling-up possible.

### ***Driver 3: effective and simple agroecological farming practices***

The reduction of synthetic inputs (e.g., via integrated management of soil fertility and pests) and input substitution (purchased microbial pesticides and biofertilizers) can be steps in a transition toward agroecological systems. This is what Gliessman (2015) calls level 1 and 2 agroecology: the reduction of industrial inputs and the substitution of conventional practices with agroecological practices, respectively. However, an agroecological system occurs at level 3, a focus upon integration among elements of the agroecosystem. Level 3 agroecology requires creation or strengthening of autonomous mechanisms for maintenance of soil fertility and regulation of pests and weeds, as well as synergies and complementarity in use of space, nutrients, water, and sunlight (Gliessman 2015). Such agroecological practices are based upon the maintenance of the life in the soil, enhancement of agrobiodiversity (such as the integration of crops, trees, and livestock), and farm and landscape redesign (polycultures, soil conservation, conservation of forest, or wildlife patches) (Gliessman 2015; Perfecto, Vandermeer, and Wright 2009).

In their respective initial phases, India's ZBNF and Cuba's agroecological revolution (lead by ANAP) were based primarily upon input-substitution practices, including biofertilizers, efficient microorganisms, botanical pesticides, biological control agents, and (in Cuba) vermicomposting. More integrative (level 3) agroecological practices promoted in our cases included ZBNF's use of mulch and native cow manure to enrich and protect soil

and to close nutrient cycles. Similarly, *Ecovida* promoted organic-matter incorporation, erosion prevention, and use of green manures. Farmers in Cuba, Chiapas, and Central America used green manure, incorporation of organic matter, hedgerows, and contour barriers. Organic coffee farmers in Chiapas also used compost, microbial soil regeneration, mulch, and weed management for prevention of soil erosion.

To increase biodiversity and related agroecosystem functions at the farm level, the movements we describe in India, Chiapas, and Cuba promote polycultures and agroforestry systems (e.g., diversification of shade trees in coffee plantations; integration of livestock with crops and trees; and integration of fruit trees with sugar-cane diversification). The Cuban and Brazilian organizations foster local seed selection, production, and exchange. We found no evidence that the movements we studied promote protection and restoration of wild areas within or adjacent to agricultural landscapes, even though that practice is important for maintaining agroecosystem function (e.g. Perfecto, Vandermeer, and Wright 2009).

Despite the frequent lack of integrative practice at the farm and landscape level, the massification efforts noted in our five cases have reduced external inputs and production costs while increasing production. For example, ZBNF farmers have achieved better yields using less water and fewer off-farm inputs (Khadse, Rosset, and Ferguson 2017). In Nicaragua, members of the CaC movement saw their costs decline while their yields increased by 300% (Holt-Giménez 2006).

Our analysis of these cases suggests that simple, level-2 practices and recipes may be important for early adoption. More complex practices that depend upon a more sophisticated understanding of ecological relationships at the farm and landscape levels advance at a slower pace. As the rapid adoption of Green Revolution packages demonstrates, technologies that give quick, visible results appeal to farmers. More complex agroecological management, practices that accrue benefits more slowly, and those that require landscape-level coordination may be more difficult to promote, particularly because their benefits, while substantial, can be diffuse and difficult to observe. This is why the CaC methodology is based on starting slowly, with simple practices likely to give rapid results. Early success motivates farmers to stick with the process, and more complicated practices are introduced gradually (Holt-Giménez 2006; Machín Sosa et al. 2013).

#### ***Driver 4. Constructivist teaching–learning processes***

Teaching–learning processes used by movements that have scaled out agroecology promote the active inclusion of traditional/local/contemporary knowledge, as well as development of autonomy. Pedagogy is predominantly

horizontal. For example, farmer-to-farmer methodology, congruent with Paulo Freire's constructivist<sup>5</sup> principles (Freire 1970; Holt-Giménez 2006), was used in all five cases. These teaching methods guarantee collective, horizontal learning, discussed variously as the co-creation of knowledge (Coolsaet 2016), and “*diálogo de saberes*,” dialog among different “knowledges” or ways of knowing (Martínez-Torres and Rosset 2014). The common objective is recognition of peasant knowledge and cultivation of peasant protagonism in place of conventional agricultural extension, in which peasants play a more passive role (Altieri and Toledo 2011; Holt-Giménez 2006; Rosset et al. 2011; Scoones and Thompson 1994). All five emblematic cases built upon traditional and local practices, especially for the rescue of native seed varieties and animal breeds.

The teaching–learning processes in the cases we studied integrate spiritual/emotional/ideological components with technical training, enabling people to experience meaningful learning (Ausubel 1983). For example, the farmer-to-farmer method demands work with “head, heart, and hands,” that is, cognitive, emotional, and practical elements (Holt-Giménez 2006). The spiritual component is evident in Chiapas's organic coffee boom and the CaC Movement in Mesoamerica, both of which are influenced strongly by Liberation Theology's see-judge-act praxis and by indigenous cosmovision (Boff 1994). Somewhat similarly, the ZBNF is embedded in spiritual values that allow peasants to connect with agroecological practice. In all five cases, teaching–learning processes are accompanied by a clear ideological posture. The educational programs in each case include processes for systemic analysis of macro-level socioeconomic, cultural, and political contexts. These pedagogical practices resonate with Vigotsky's sociocultural theory, which states that social interaction, culture, and historical context play a fundamental role in the development of cognition (Carrera and Mazzarella 2001; McCune et al. 2016).

Although *Rede Ecovida* and Mesoamerica's CaC movement collaborated with local schools, the emphasis in all five cases is on informal education. Thus most training takes place outside of formal institutions, using methodologies coherent with critical pedagogy, peasant protagonism, and autonomy. Significant elements include use of materials suitable for local conditions, mutual visits among peasants, and practical activities in meaningful places – such as their own fields – that make learning meaningful. The methodologies are based upon teaching by example; what teachers often call “modeling ethically and practically” (McLaren 2001:79). This “pedagogy of

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<sup>5</sup>Delval (2000, 78) considers constructivism to be “a psychological and epistemological position that tries to explain how knowledge is formed [...] Constructivism proposes that subjects need to build their knowledge and that knowledge cannot be given already built. This theory states that subjects form their knowledge based upon the knowledge they already have, testing it and contrasting it with their physical and social reality” (translation by authors).

the example” is understood in Latin American social movements as a continuation of the thinking of José Martí and Ernesto “Che” Guevara (Barbosa and Rosset 2017; Turner 2007). For example, training groups visit farms that employ efficient agroecological practices because seeing results first-hand inspires peasants to emulate these practices. Furthermore,

Farmers learn from each other by sharing wisdom, creativity and knowledge, not just information and techniques. Rather than simply transferring technologies, farmers first and foremost “make culture” - sharing that leads to action builds a culture of sustainable agriculture. Technology transfer is actually just one (and not always the primary) component of this cultural matrix Holt-Giménez (2001, 27).

The teaching–learning processes used in the five cases are supported by auxiliary materials that include books, booklets, radio, TV programs, and even intense interchanges of ideas on social networks such as Facebook and (in India) cell-phone-based communication (Khadse, Rosset, and Ferguson 2017). The pedagogical components of agroecological scaling stimulate peoples’ creativity as well as their active participation and full recognition of themselves and others as subjects (Brescia 2017; McCune et al. 2016, 2017). In McCune et al. (2016), we further argue that peasant organizations are implementing these critical pedagogies in ways that use *territory* itself as a pedagogical mediator in bringing agroecology to scale.

### **Driver 5. Mobilizing discourse**

The theory of collective action holds that *discourse* is a key element in social mobilization processes when it allows the definition or framing of a common problem, a shared adversary, a horizon of struggle, a common identity, and common principles (Touraine 1994). The ability to establish a clear, easily understandable discourse or frame that helps promote social action in a way that is understood and reproduced by the collective is important for the scaling of agroecology. Successful agroecology movements combine “agroecology as farming” (farming practices that work) with “agroecology as framing,” a discourse that (among other things) motivates peasant and farmer families to undertake sometimes-difficult agroecological transformations (Martínez-Torres and Rosset 2014; Rosset and Martínez-Torres 2012).

In all cases analyzed, the discourse has been heavily politicized against the agro-industrial system of the Green Revolution. Beyond that, for agroecological discourse to be effective, it must be culturally relevant in each specific context. For example, Palekar’s ZBNF discourse amalgamates a critique of the exploitative, anti-peasant system, dominated by transnational corporations and Western culture, with metaphors from Hindu mythology and Gandhian principles of personal change, austere life, non-violence, and responsibility to Mother Earth (Khadse, Rosset, and Ferguson 2017). In

Cuba, criticism of the agro-industrial model hybridizes with food sovereignty, the care of nature, the revolution's socialist values, the pride of being a farmer, and the words of José Martí (Machín Sosa et al. 2010, 2013).

The mobilizing dialog in the -coffee movement in Chiapas and CaC Movement in Mesoamerica, which are influenced by Liberation Theology, strongly questions both the dominant development paradigm and the technological path of the Green Revolution, while espousing faith, autonomy, love for Mother Earth, defense of the territory and culture, and the cosmologies and ancestral knowledge of Mesoamerican peoples (Hernández-Castillo 2010). In the south of Brazil, another region strongly influenced by liberation theology, the discourse of *Rede Ecovida* against agrochemicals and the commercialization of industrialized foods in large supermarkets and promoting care of nature and health have helped create a common identity shared by the consumer movement and agroecological farmers.

In summary, each of the five cases is marked by a framing discourse, based upon culturally, spiritually, and contextually appropriate principles and values that recognized the worth of farmers and indigenous peoples. Each discourse has been effective because it motivates the movements' members to stand against the agro-industrialized system and to take up agroecology as the alternative to the harmful Green Revolution model.

### **Driver 6. External allies**

External allies have played a vital role in each of our case studies. The resources and support that allies bring to the scaling process take a variety of forms: publicity; material (e.g. funds); moral (e.g. social legitimacy); and organizational or human (e.g. knowledge, abilities, and volunteers). The support of allies comes from various areas, including government, media, academia, political parties, religious institutions, and NGOs. Allies include institutions and, more commonly, individuals within institutions that do not normally support agroecology. Those individuals include sympathetic government officials able to redirect public resources.

Key allies of the ZBNF movement are Hindu ashrams that provide free accommodation and food for training camps, as well as social legitimacy. The peasant movement has provided organizational support, spreading agroecology through its grassroots structure. Tech-savvy individuals have given ZBNF communication support with a wide Internet presence through various blogs, forums, and other websites where online exchanges occur among both rural and urban farmers. Some shops provide favorable market outlets. Influential individuals, including a few entrepreneurs, politicians, actors, and government officials, have given the movement visibility in mainstream media and pushed for favorable public policies (Khadse, Rosset, and Ferguson 2017).

Essential allies of the CaC movement in Central America included NGOs and peasant organizations that brought ideas, funding, and organizational resources. The movement began with mostly financial, though also technical support from World Neighbors and Bread for the World (Holt-Giménez 2006). In Nicaragua, support from German Protestant and Catholic churches played an important role (Salazar 2014). Participants also credit NGO support as key to introducing a gender-equity perspective to the movement (Holt-Giménez 2006).

In Cuba, various government agencies have been important allies of the CaC movement. Supportive public policies like land reform were key pre-conditions for the success of CaC. Allied peasant organizations in Central America, supported by international NGOs, were fundamental in introducing CaC methodology to Cuba in the late 1990s. NGOs and universities have provided research, technical, and other types of support. Groups including the Cuban Association of Agriculture and Forest Technicians (ACTAF), the Cuban Animal Production Association (ACPA), and the international-national public sector Innovation Program on Local Agriculture played similar roles. The dominant ideology of the Ministry of Agriculture remains that of large-scale industrial agriculture. However, the movement has won many favorable public policies, “at least until trade relations are normalized.” In the meantime, Cuba boasts some of the world’s most supportive policies for agroecology (listed in Machín Sosa et al. 2010, 2013). The Brazilian agroecology movement grew as an alliance of alternative agriculture NGOs, members of local, ecological agriculture initiatives, and farmers’ organizations. The Federation of Family Farmers (FETRAF) joined early on. Subsequently, the Landless Workers’ Movement (MST) – an LVC member supported – added its strength and numbers to the movement. The alliance later helped create the Brazilian Agroecology Association (ABA) and the National Agroecology Articulation (ANA), both of which are national groupings of agroecology NGOs, movements, and scientists. Regional networks like *Rede Ecovida* in southern Brazil formed as partnerships among farmers, scientists, consumers, and some parts of government to establish localized agroecological food systems. These alliances have strengthened the movement’s capacity to react to political opportunities and advocate for favorable policies.

In Chiapas, Mexico, the influence of Presbyterian and Catholic clergy who adhered to liberation and indigenous theologies promoted organic coffee as part of a revival of the traditional Mayan culture. Also critical was the capture of coffee processing infrastructure by peasant cooperatives – aided by sympathetic government officials – when IMECAFE was privatized.

In summary, the five cases show that external allies play key roles in the amplification of agroecology movements, providing support to farmers, channeling resources, motivating articulations between social sectors, and

strengthening lobbying capacity. Nevertheless, there may be a fine line between using support from allies for building the internal strength of autonomous, bottom-up processes versus creating high levels of dependence on external actors and/or policies and that put the medium- and long-term sustainability of the process in jeopardy (Rosset and Altieri 2017).

### ***Driver 7. Construction of markets favorable to agroecology***

The development of alternative food networks (AFN) is not a necessary condition for the widespread adoption and adaptation of agroecological practices by farmers, as the lack of such in the cases of ZBNF in India and CaC in Nicaragua show. Nevertheless, in many instances, markets are a strategic sociopolitical arena for scaling agroecology (Hebinck, Schneider, and Van Der Ploeg 2014; Pretty 2001). For Gliessman (2015), building “food citizenship” through participation in AFNs is the fourth level of agroecological conversion. Reciprocal arrangements such as solidarity networks have often been central to the advance of ecological farmers’ markets and the socioeconomic viability of agroecology (Gliessman 2015; Granovetter 2005; Henderson and Casey 2015; La Via Campesina 2015; Parmentier 2014; Van Der Ploeg 2012).

These market arrangements can be driven by consumers of internationalized goods, as in the case of certified fair-trade and organic coffee produced in Chiapas (Martínez-Torres 2006). The arrangements can also be based upon local and regional food markets, such as those organized by *Rede Ecovida* in Brazil. Alternatively, they can be driven by public policies that support small farmers and agroecological production, as in the cases of Cuba’s strong support for cooperative formation and tight arrangements for purchasing their production, and the Brazilian Federal Food Acquisition from Family Farming (PAA) program (Wittman and Blesh 2017). The socioeconomic and ecological effects may vary according to the type of market arrangements, but arrangements that prove helpful to massification of agroecology contribute to food-system transformation by differentiating agroecological production from the general market.

The spread of organic and fair-trade coffee production in Chiapas has clearly been market-driven, with the conformation of peasant marketing cooperatives and the arrival in the 1990 of European buyers in search of organic coffee production (Martínez-Torres 2006). Because coffee has proven vulnerable to external factors such as market swings and crop diseases, cooperatives have sought to diversify in recent years. This effort is reflected in their search for other fair-trade products (e.g. honey) as well as food for self-sufficiency and local markets.

The Cuban case exemplifies a strong involvement by the State in managing the food market, from supporting the conformation of farmers' cooperatives throughout the country and awarding them purchasing contracts to ensuring crop prices that give market guaranties to farmers. These market arrangements in Cuba contribute to the persistence and growth of scaling processes that originate in the drivers described above.

The *Rede Ecovida* exemplifies an agroecology movement formed around an AFN. Through actions including conforming nested market circuits that connect producers and consumers, and a network of local seed production, the *Rede* has become the principal social platform for a solidarity-economy movement spanning three states in southern Brazil (Perez-Cassarino 2012; Rover 2011; Rover, Corrado De Gennaro, and Roselli 2016). *Ecovida's* decentralized, horizontal structure articulates diverse actors through market arrangements for agroecological products that transform local and regional food systems.

The multiple market mechanisms used to strengthen agroecological movements correspond to the need for social innovation adapted to different situations and challenges. Although we question whether AFNs are a necessary condition, market conditions can determine the rhythm at which agroecology goes to scale. The cases we studied lead us to suggest that transformative potential is enhanced when movements use markets as spheres of sociopolitical action. This process is not necessarily contingent upon state intervention, although social movements created around these market strategies can influence state practices and public policy.

### ***Driver 8. Favorable policies and political opportunities***

Policies, including private- and public-sector initiatives, can complement and enhance efforts for scaling agroecology (Parmentier 2014). The most-significant examples involve reformulation and roll-back of policies supporting the reproduction of the agro-industrial model, instead supporting pathways based upon agroecological principles. Examples include programs for small-scale farmers in Brazil and Cuba.

State involvement has been present in all our cases of scaling or institutionalization of agroecology, but to variable degrees. Policy assuring access to land and different types of land reform establishes necessary conditions for scaling. In Mexico's organic coffee movement, the state had limited involvement, and the dismantling of a state marketing program created a political opportunity, allowing peasant organizations to influence market arrangements and regulatory frameworks. Similarly, the ZBNF movement in India emerged from a farmers' movement, and only after the movement gained strength did the government respond by providing resources for a peasant agroecology school. In the Cuban and Brazilian cases, the actions of social

movements, including peasant organizations and unions, won significant state support, including public policies to reinforce movement strategies contributing to agroecological scaling.

No single policy emerges as essential; rather, combinations of complementary policies are needed to tackle the various issues at stake in the transformation of agri-food systems. In Cuba, scientists and farmers demanded public policies in the farming, education, and market sectors to strengthen agroecology. Examples include programs to promote biological control, urban agriculture, organic matter recycling, participatory plant breeding, backyard livestock, changes in the school curricula, acquisition of agricultural products by the government, and new stages of land reform policies that provide peasant access to unproductive land (Machín Sosa et al. 2010, 2013). These agroecologically focused policies prospered within the context of national policies that maintain high standards of education, health, and technical capacity for farmers, as well as special-period policies to ensure farmers' access to land, credit, and markets.

The Workers' Party governments in Brazil also adopted a long list of policies to support agroecological practices (Caporal and Petersen 2011; Petersen, Mussoi, and Soglio 2013), though these policies never threatened the dominance of the industrial agri-food system and many of them are being rolled back by the new government that entered via a parliamentary *coup d'état* (Oliveira and Baccarin 2016; Rosset and Altieri 2017). The latter reinforces the concern that public policy support can create dependencies that weaken social movements over time. In Brazil, the cutback of policies that supported cooperatives and incipient agro-industrial projects for family farmers means that these enterprises now have difficulty covering their costs (Oliveira and Baccarin 2016).

Coherence among policies is fundamental (Parmentier 2014), and the depth of policy changes required for systemic transformation has yet to materialize. For example, in Brazil, a large country with a strong agricultural-export economy, diverse socioeconomic groups have gained space for their interests, including peasants and family farmers. However, the sum of all the policies they have won from the state is tiny in comparison to ongoing state support for agribusiness (Itaboraí 2013). Small-scale farmers compete on unequal footing because policies that attempt to promote family farming and agroecology are in tension with more-entrenched policies that support large-scale monoculture production. A similar situation is seen in Cuba, where many national policies now support agroecology, but policy lock-ins (e.g. institutions) and path dependence (e.g. infrastructure) mean industrial agriculture dominates the agenda of the Ministry of Agriculture, which hopes for normalized trade relations.

## Discussion

The five cases of agroecological massification that we analyzed have been sparked by crises and fueled by strong organizational structures within social movements capable of channeling the collective response to those crises. This sort of process gathers strength as constructivist pedagogical methods are employed, as farmers recognize the efficacy of agroecological practices, and as alliances enhance momentum. In addition, favorable markets and policies broaden opportunities for transformation of the agri-food system.

While the relative importance of the drivers for scaling agroecology varies among the five cases (Table 1), we detect some patterns. Perhaps the most important of these is that scaling is multidimensional, resulting from convergence of several drivers. Crises were present in all the cases we studied and in some instances seemed to set scaling processes in motion. However, successful response to crises and opportunities seems to require a well-developed, preexisting organizational fabric.

Stated differently, organization and social fabric constitute the culture medium on which agroecology grows. They provide the structure through which values, meanings, lessons learned, and horizons of political action circulate. They also provide opportunities to design and implement processes like CaC and to link with external allies.

“Organizational structure” should not be interpreted as referring to a static arrangement. Rather, a movement’s organizational structure can grow as agroecology is amplified to articulate smaller organizations and extend their reach. Such was case of *Ecovida*, where a network was created as part of the scaling process. Nor does the organizational structure have to be formal. India’s ZBNF movement escalated through a partially spontaneous network and through interactions that were not institutionalized. Moreover, many farmers practice agroecology without formally joining any organization. Still, the reach of the organizations may determine to a large extent the scope for scaling agroecology (Rosset et al. 2011).

**Table 1.** Relative importance of drivers contributing to agroecological massification in the five analyzed cases (rated from 1 to 5, consensus of the authors).

Drivers	Cases				
	Cuba	Central America	Chiapas	India	Brasil
Crisis	4	2 .5	3 .5	3 .5	1 .5
Social organization, process	4	3 .5	3 .5	3 .5	3 .5
Effective agroecological practice	3 .5	3 .5	3 .5	3 .5	3
Mobilizing discourse	3	2	2	3 .5	2
Constructivist pedagogy	3 .5	3 .5	2	2	2 .5
External allies	2 .5	3 .5	3	3	3
Favorable markets	2	1 .5	4	1 .5	3 .5
Favorable policies	3	1 .5	2 .5	1	3

Horizontal, constructivist pedagogies and methodologies, such as CaC, seem to be crucial for bringing agroecology to a territorial scale. The dissemination of agroecology and the transformation of productive practices have been achieved, thanks to such methods, based upon dialog of knowledges. According to Rosset et al. (2011, 168–9):

Methods in which the extensionist or agronomist is the key actor and farmers are passive are, in the best of cases, limited to the number of peasant families that can be effectively attended to by each technician, because there is little or no self-catalyzed dynamic among farmers themselves to carry innovations well beyond the last technician. . . A fundamental tenet of CaC is that farmers are more likely to believe and emulate a fellow farmer who is successfully using a given alternative on their own farm than they are to take the word of an agronomist of possibly urban extraction. . . Whereas conventional extension can be demobilizing for farmers, CaC is mobilizing, as they become the protagonists in the process of generating and sharing technologies.

Peasant promoters need thorough preparation in the methodological approach, lest some of them follow the example of experts from extension programs by imposing rather than facilitating, and by prescribing methods rather than participating in processes (Machín Sosa et al. 2010, 2013). When peasant promoters do act like extensionists, the process typically remains centralized in a few farmers and loses momentum. It is essential that agroecological practice and critical pedagogies walk hand in hand and so that new proposals can be tailored to new contexts.

In most of the five cases, input substitution strategies proved attractive to farmers. However, we maintain that agroecology movements need to move beyond input substitution to benefit from synergistic interactions in more fully integrated agroecological systems (Vandermeer and Perfecto 1997; Morales 2002; Gliessman 2015). However, this transition is well developed only in the Cuban case (Rosset et al. 2011). These observations raise important questions about processes of transition and transformation, such as, would it be possible to start with greater complexity and an emphasis on prevention? Or is it best to first capture the attention of farmers with the quick results obtainable through input substitution? Might a focus upon input substitution perpetuate linear, cause-and-effect, “recipe” thinking? Can framing around traditional cosmovisions promote complex thinking and practice, through ways of knowing that recognize the interconnectivity among agroecosystem elements (Aldasoro 2012)?

The processes we studied were championed and led by peasants and farmers. Indeed, peasant farming and protagonism are at the center of farmers’ movements and agroecology alike, leading to a natural affinity. Van Der Ploeg (2013) suggests – and our cases corroborate – that agroecology appeals to farmers in part because it diminishes their dependencies and builds their autonomy. Thus, agroecological movements are strongest when not overly dependent upon external structures originating from NGO

projects, research institutions, or public policies. On the contrary, agroecological movements foster constant conformation of farmer and peasant leadership that gives them leverage and strength.

Even so, in the cases analyzed, the role of the external allies has been important. One lesson is that while it is necessary that farmers' organizations manage the process, external allies can play a fundamental role by contributing to specific aspects that the organizations cannot cover adequately on their own. Moreover, on a more normative note, the deep transformation that agroecological movements are advocating will require sharing of the struggle and costs – be they material, political, or cultural – among different groups in society. Loading all the required effort onto the farmers may impose a limit on scaling. At a certain point, alliances (including *dialogos de saberes*) then become critical for strengthening agroecological knowledge and rural–urban linkages, as well as for influencing policy and market dynamics.

We and many other authors believe that the participation of women is critical to scaling agroecology (Parmentier 2014; Siliprandi 2015; Siliprandi and Zuluaga 2014). With the exception of the CaC movement (Holt-Giménez 2006), we did not find evidence that women's involvement was explicitly fostered in the cases we studied. Yet women play diverse roles in agriculture, and their traditional responsibility for nurturing families and communities, mentally and physically, gives women a profound and complex understanding of agri-food systems (Allen and Sachs 2012). In addition, women have undertaken leadership in movements to advance and develop agroecology and resist unjust agrarian models and territorial exploitation (Martínez-Alier 2002; Siliprandi 2015; Tait 2015; Tapia 2016). Our field experience and reading lead us to believe that in many – or perhaps most – cases, it is women who encourage and implement agroecological change within families, both directly and by influencing men (Siliprandi 2015). Holt-Giménez (2006) notes that women are often the guardians of biodiversity in fields and gardens and have a strong influence in decisions about which crops and varieties to plant.

In the same way, it is important to understand the role of youth in agroecological scaling. Although youth were not central to the cases we analyzed, peasant movements are currently emphasizing youth leadership and training (McCune, Reardon, and Rosset 2014; Barbosa and Rosset 2017; McCune et al. 2016, 2017). Young people who stay in the countryside or return to it usually have a more agroecological vision than the previous generation. Youth seem to be advancing agroecology (McCune et al. 2016, 2017), and agroecological schools equip young peasants with both technical and political skills.

Public policies were not among the most important early drivers of scaling in the cases we analyzed. Typically, such policies had to be won through the movements' advocacy or struggles and on the basis of successes already

achieved. For example, ANAP's influence on Cuban policies was proportional to that bottom-up movement's ability to boost agroecological production. Brazilian policies in favor of agroecology and family farming were won by the struggle of peasant and family-farm social movements, with the help of allies in NGOs and other sectors. Even where favorable policies were in place when movements began, those policies tended to contribute only after the scaling processes had already gained momentum.

Parmentier (2014, p.59) argues that “unlocking ideological barriers to political recognition of the socioeconomic and environmental importance of farmers and agroecology” is crucial in the policy-making process. However, in the cases analyzed here, changes in policies have by and large been marginal. Even the inclusion of food sovereignty in countries' constitutions (e.g. Ecuador) has had little effect so far. The governments of Bolivia, Uruguay, and Argentina have given lip service to agroecology, but their overarching political economies remain hostile (Montagut, Gascón, and Riera 2010; Vergara-Camus and Kay 2017).

A further complication is that policies promoting the institutionalization of agroecology may cause farmers' organizations to lose control of the massification process, thereby weakening movements (Levidow, Pimbert and Valorqueren 2014; Giraldo and Rosset 2016, 2017). Another risk, associated with the current trend toward institutionalization of agroecology in the FAO and other national and international venues (Giraldo and Rosset 2016, 2017), is the cooptation and capture of “agroecology” policies by agribusinesses eager to be “greenwashed.”

The discussion of policies raises the issue of markets as well. The cases we explored lead us to suggest that while markets can attract people to agroecology, scaling based principally upon market opportunities can be vulnerable to external changes. Thus, market mechanisms should be designed to strengthen social movements, not to be a central driving force thereof. Markets have not been indispensable to the increase in agroecological production, but failure to consider markets can be an Achilles heel. Markets contribute most to agroecology movements in cases like *Rede Ecovida* and Chiapas's organic coffee production, where they are nested within networks whose unifying elements are environmental and social values. *Rede Ecovida* assures compliance with those values through a participatory guarantee system that builds internal capacity and relationships rather than perpetuating reliance on external certification (Radomsky and Leal 2016). Alliances created around market mechanisms have the potential to extend the reach of agroecology's transformative power to realms other than production. We note, too, that large-scale transformation of agri-food systems will be difficult until demand for agroecological products increases and until stronger relationships between producers and conscious consumers are developed.

## Conclusions: a new field of research and construction of alternatives?

In this analysis, we have identified eight drivers that were important, to varying degrees, in the scaling of agroecology in five cases that we consider emblematic. The analysis is preliminary and does not fully address elements such as the roles of women and youth nor transformations at the scale of alternative food regimes. Nevertheless, we believe that the patterns revealed contribute to understanding of agroecological scaling in diverse contexts.

We have barely addressed interactions among the various dimensions of agroecological scaling and the importance of the “quality” of each in particular cases. Much more detail is needed on how these dimensions can interact to generate positive feedback. In particular, we believe it important to advance research that systematically studies how public policies can accompany existing efforts, helping them grow more autonomous and better organized rather than generating risky dependencies. Research is also needed on the role of public policy in catalyzing the emergence of new processes.

We have focused upon aspects that favor the scaling of agroecology, but we should not ignore the importance of analyzing elements that limit the expansion of agroecology. Those elements include paternalistic, clientelistic, demobilizing relations; public policies that facilitate land concentration and land grabbing; and actions of governments and international and market institutions that foster the expansion of agribusiness and industrial monocultures (Giraldo 2018; Rosset and Altieri 2017). Nor have we considered other obstacles, such as the lack of organization and/or mobilizing leadership, the hegemonic power of the dominant agricultural development paradigm, and the insidious effects of the coloniality of knowledge. We need to deepen an understanding of how to scale agroecology in the context of neoliberal globalization, where these limiting aspects constitute the rule rather than the exception.

Scaling of agroecology is both a relatively new research field and a real-world phenomenon with great potential (Parmentier 2008; De Schutter 2010b). The havoc being caused by the Green Revolution model makes scaling urgent: agroecology must transcend individual plots and farms, to become the norm on the scale of territories, rural–urban constellations, and nations (Gliessman 2015; Rosset 2015; Rosset and Altieri 2017), extending to the global agri-food system, level 5 in Gliessman’s (2015) scale of agroecological conversion. We believe that this expansion requires greater capacity for articulating the ecological and social-science aspects of agroecology and for transdisciplinary associations with social movements that defy corporate agribusiness and the industrial agri-food system while building alternatives (Méndez, Bacon, and Cohen 2013; Ferguson 2015).

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